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NASA CASE NO. MFS-28521-1
PRINT FIG. #3

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NASA CASE NO. MFS-28521-1

DOUBLE FACE SEALING DEVICE

TECHNICAL ABSTRACT

A double face sealing device for mounting between two surfaces to provide an airtight and fluid-tight seal between a closure member bearing one of the surfaces and a structure or housing bearing the other surface which extends around the opening or hatchway to be closed. The double face sealing device includes a plurality of sections or segments mounted to one of the surfaces, each having a main body portion 24, a pair of outwardly extending and diverging, cantilever spring arms 28, and a pair of inwardly extending and diverging, cantilever, spring arms 26, an elastomeric cover on the distal 38, free, ends of the outwardly extending and diverging spring arms, and an elastomeric cover on the distal, free, ends of the inwardly extending and diverging spring arms. The double face sealing device has application or use in all environments requiring a seal, but is particularly useful to seal openings or hatchways between compartments of spacecraft or aircraft.

| | |
|----------------|-------------------|
| Inventors: | Bruce Weddendorf |
| Employer: | NASA/MSFC |
| Date Filed: | February 19, 1991 |
| Serial Number: | 657,586 |

DOUBLE FACE SEALING DEVICE

ORIGIN OF THE INVENTION

The invention described herein was made by an employee of the United States Government and may be manufactured and used by
5 or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

FIELD OF THE INVENTION

The present invention relates to a double face sealing device for mounting between two surfaces to provide an airtight
10 and fluid-tight seal between a closure member bearing one of the surfaces and a structure or housing bearing the other surface which extends around the opening or hatchway to be closed. The double face sealing device of the present invention is particularly adapted for providing an easily renewable,
15 long-term, ultra low leakage seal for use in spacecraft or aircraft to contain the atmosphere therein, but it is also useful in almost all environments requiring a seal between compartments or between a compartment and the outside thereof.

BACKGROUND OF THE INVENTION

20 There are many prior art devices for sealing a closure member and an opening or hatchway in a housing. A vast majority of such prior art devices provide only a single seal and not a redundant or double seal as does the present invention. None of the known prior art devices are suitable for long term use on

spacecraft or aircraft to seal low pressure atmosphere against vacuum. Most known prior art devices used with spacecraft or aircraft include elastomeric O-rings and other purely elastomeric seals, metal seals, elastomeric seals molded into metal gasket plates, or internally sprung elastomeric or plastic seals.

There are also various patents which relate to devices for providing a seal between adjacent surfaces of a closure member and a compartment. These patents generally teach the use of a single seal only which is not normally intended for use in spacecraft or aircraft. U. S. Patent No. 2,686,343 discloses a sealing device for a pressurized aircraft including an elongated elastomeric tube. U. S. Patent No. 3,308,727 discloses a sealing device for use between a manhole and a manhole cover comprising a cushioning ring having an outer ring member and an inner ring member having diverging arms. U. S. Patent No. 3,763,595 discloses an elastomeric seal for providing a fluid-tight seal between a closure member and a structure extending around the opening of a hatchway. U. S. Patent No. 3,777,424 discloses a weather seal for a railway car door, which seal is formed of an elastomeric material. U. S. Patent Nos. 1,906,110, 2,827,280, 3,284,957, 4,474,344, and 4,535,565 are illustrative of other prior art devices for sealing between compartments or between a compartment and the outside thereof.

The prior art sealing devices, particularly when used on spacecraft or aircraft, have numerous disadvantages or drawbacks. For example, those sealing devices which rely upon

an elastomer to maintain the sealing contact force are subject to failure over a period of time due to the compression set of the elastomer and it is extremely difficult to replace the elastomer only. Metal seals normally require large clamping
5 forces to seal, thus necessitating stiff, heavy, flanges which are not adaptable for lightweight spacecraft or aircraft. Currently available metal seals and internally sprung elastomeric or plastic seals are extremely rigid and of one piece, and, if used on a circular opening or hatchway, cannot
10 fit through the opening or hatchway to be sealed. Most prior art sealing devices also require a relatively large space for storage of spares and are difficult to mount. Many of the prior art sealing devices also require special machining since they are mounted in a recess or groove. Many prior art sealing
15 devices are not constructed such as to permit the replacement of the elastomeric material only, but require the replacement of the entire sealing device.

The present invention overcomes the numerous disadvantages, drawbacks or deficiencies of the prior art devices in that it
20 provides a redundant (two sealing points) elastomeric seal energized by metal springs while allowing the easy replacement of the elastomers independently of the metal springs. The metal springs maintain the stress in the elastomers over a very long period of time, well beyond the time a pure elastomeric seal
25 would have failed due to compression set. The surfaces which the seal of the present invention interfaces with can be smooth, with no special machining being required except for simple

tapped retention holes; thus lowering costs and simplifying the elastomer replacement process.

Accordingly, it is an object of the present invention to provide a new and improved device for sealing the opening or
5 hatchway between two compartments or one compartment and the outside.

It is a further object of the present invention to provide a double face device for mounting between two surfaces to provide an airtight and fluid-tight seal between the surfaces.

10 It is still a further object of the present invention to provide an easily replaceable, long lasting, ultra low leakage seal for use in a spacecraft or aircraft to contain the atmosphere therein.

It is yet a further object of the present invention to
15 provide a long lasting, redundant (two sealing points), elastomeric seal energized by metal springs which maintain the stress in the elastomeric seal over a very long period of time, well beyond the time a pure elastomeric seal would have failed due to compression set.

20 Other aspects, objects, and advantages of this invention will become apparent to those skilled in the art to which this invention pertains from a study of the preferred embodiments as set forth in the specifications, drawings, and the appended claims.

25

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a top plan view of the double face sealing

device of the present invention.

Figure 2 is a sectional view taken along line 2-2 of Figure 1 illustrating one embodiment of the sealing device of the present invention.

5 Figure 3 is a partially broken away, fragmentary, view showing the sealing device of Figure 2 in a compressed or sealing state.

Figure 4 is a view similar to Figure 2 illustrating another embodiment of the sealing device of the present invention.

10 Figure 5 is a view similar to Figure 2 illustrating a further embodiment of the sealing device of the present invention.

Figure 6 is a view similar to Figure 2 illustrating yet another embodiment of the sealing device of the present
15 invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to the drawings, Figures 1-3 are illustrative of one embodiment or application of the seal of the present invention. As illustrated, the seal is generally designated by
20 reference numeral 10 and is shown in a circular configuration for sealing a round opening or hatchway 14 (Figure 3) in a housing or compartment 12 by a door or hatch 18. Seal 10 comprises a plurality of sections or segments 22, each having a main body portion 24, a pair of outwardly extending and
25 diverging, cantilever, spring arms 26, a pair of inwardly extending and diverging, cantilever, spring arms 28, and a

countersunk hole 30. Each spring arm 26 includes a projection 27 at its distal end which extends outwardly from spring arm 26 at an angle in the order of 70 degrees to 100 degrees with each spring arm 28 including a projection 29 at its distal end which
5 extends outwardly from spring arm 28 at an angle in the order of 70 degrees to 100 degrees. Each section or segment 22 is secured to a shoulder or surface 16 (Figure 3) of housing or compartment 12 which surrounds the opening or hatchway 14 by threaded fasteners 32 engaged with spaced, tapped, retention
10 holes 34 in shoulder or surface 16 of housing or compartment 12. Reference numeral 36 designates the break lines between sections or segments 22. An outer, replaceable, elastomeric cover 38, including a pair of inwardly extending flanges 40, is placed or slipped over the ends of diverging spring arms 26,
15 with the inwardly extending flanges 40 being snapped over the projections 27 for grasping the diverging spring arms 26, to positively retain the outer elastomeric cover 36 upon spring arms 26. An inner, replaceable, elastomeric cover 42, including a pair of inwardly extending flanges 44, is placed or slipped
20 over the ends of diverging spring arms 28, with the inwardly extending flanges 44 being snapped over the projections 29 for grasping the diverging spring arms 28, to positively retain the inner elastomeric cover 42 upon spring arms 28.

The embodiment of the sealing device as illustrated in
25 Figure 4 is substantially identical to that shown in Figures 1-3 except that the spring arms 50 and 52 are formed separately from the main body portions 24 and are secured to main body portions 24 by any conventional means such as a weld 54 instead of being

formed integral with the main body portion as is done with the embodiment of the invention illustrated in Figures 1-3. The embodiment of the invention illustrated in Figure 4 might be considered in environments wherein the hatchway or opening
5 between the compartments are relatively large.

The embodiment of the sealing device as illustrated in Figure 5 is substantially identical to that shown in Figures 1-3 except that one spring arm 60 is generally C-shaped in cross-section and the other spring arm 62 is generally E-shaped
10 or serpentine in cross-section, with both spring arms 60 and 62 being formed separately from the main body portion 24 and being secured to main body portions 24 by any conventional means such as a weld 64 instead of being formed integral with the main body portion as is done with the embodiment of the invention
15 illustrated in Figures 1-3. In the embodiment illustrated in Figure 5, the elastomeric covers 66 and 68 are of different configurations with the cross-section of the cover for the C-shaped spring arms 60 being as represented by cover 66 with the cross-section of the cover for the spring arms 62 being as
20 represented by cover 68. With the embodiment of the invention illustrated in Figure 5, it is possible to utilize pressure activation for both sides of seal 10 by reversing the direction of the outer seal.

The embodiment of the sealing device as illustrated in
25 Figure 6 is substantially identical to that shown in Figure 1-3 except that each spring arm 70 and 72 is formed of two independent members 74 and 76 separately from the main body

portions 24 and are secured to main body portions 24 by any conventional means such as a weld 78 instead of being formed integral with the main body portion as is done in Figures 1-3. In the embodiment of Figure 6, the outer elastomer is designated
5 by reference numeral 80 and the inner elastomer is designated by the reference numeral 82.

Only the mode of operation of the embodiment of Figures 1-3 will be described, as the operation of the other embodiments are similar and will be obvious after learning of the operation of
10 this embodiment. When it is desirable to cause a seal between door or hatch 18 and housing or compartment 12, the door or hatch 18 is moved toward the housing or compartment 12 to compress spring arms 26 and 28 and their respective covers 38 and 42 (from their cross-sectional shapes as shown in Figure 2
15 to their cross-sectional shapes as shown in Figure 3) so that the spring arms 26 and 28 and covers 38 and 42 deflect and carry loads. The relative movement continues until the flat lower surface of door or hatch 18 engages the flat upper surface of main body portions 24, at which point the seal 10 is fully
20 compressed as shown in Figure 3. The sealing force is maintained by the action of the now deformed cantilever spring arms 26 and 28 and their respective elastomeric covers 38 and 42, thus providing two independent sealed interfaces, one at elastomeric cover 38 and the other at elastomeric cover 42.
25 When in a sealed state as shown in Figure 3, the fasteners 32 float in countersunk openings 30, which are deep enough to prevent interference of the heads of fasteners 32 with the lower surface of door or hatch 18.

While the drawings depict the seal 10 as being circular or round and formed in sections or segments, it is apparent that seal 10 can be of other configurations such as being square, rectangular or ellipse, depending upon the shape of the hatchway or opening 14, and can be formed of a single main body portion instead of a plurality of sections or segments without departing from the spirit or scope of the invention. The drawings depict the main body portions in sections or segments to allow easy storage of replacement parts (segments and elastomeric covers) in a minimum area which is most important in a spacecraft on a mission of long duration.

It is also apparent that the spring arms must be sized for any given application or environment to provide sufficient sealing stress in the elastomeric covers with a margin for compression set and deflection without becoming plastically deformed.

While not shown in the drawings, it is apparent that conventional means such as hinges may be used to mount the hatch or door 18 to a housing or compartment 12 to allow relative movement and that conventional means such as latch or lock means must be used to prevent door or hatch 18 from separating to break the seal.

While the drawings illustrate the sealing 10 as being mounted on the housing or compartment 12, it is apparent that seal 10 can be mounted on the door or hatch 18 without departing from the spirit and scope of the invention.

While the above description constitutes preferred
embodiments of the present invention, it will be appreciated
that the invention is susceptible to modification, variation and
change without departing from the proper scope and fair meaning
5 of the accompanying claims.

ABSTRACT OF THE DISCLOSURE

A double face sealing device for mounting between two surfaces to provide an airtight and fluid-tight seal between a closure member bearing one of the surfaces and a structure or
5 housing bearing the other surface which extends around the opening or hatchway to be closed. The double face sealing device includes a plurality of sections or segments mounted to one of the surfaces, each having a main body portion, a pair of outwardly extending and diverging, cantilever, spring arms, and
10 a pair of inwardly extending and diverging, cantilever, spring arms, an elastomeric cover on the distal, free, ends of the outwardly extending and diverging spring arms, and an elastomeric cover on the distal, free, ends of the inwardly extending and diverging spring arms. The double face sealing
15 device has application or use in all environments requiring a seal, but is particularly useful to seal openings or hatchways between compartments of spacecraft or aircraft.

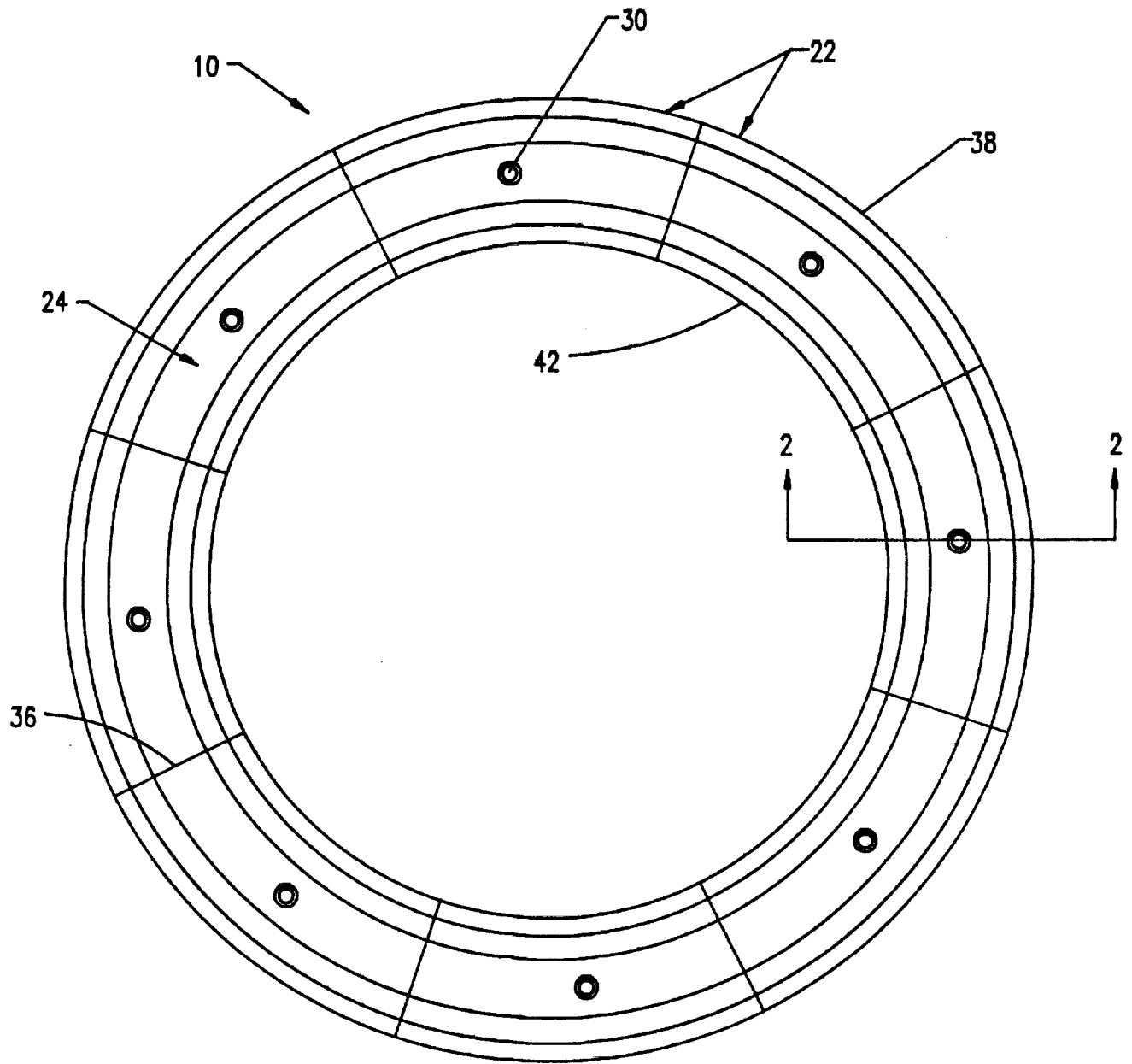


FIG. 1

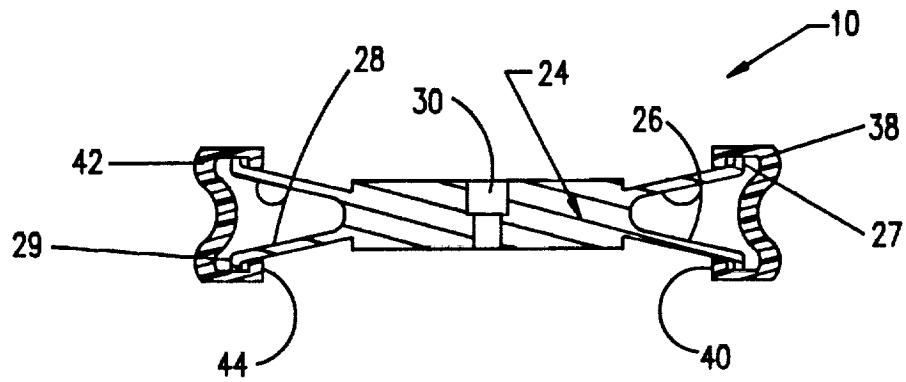


FIG. 2

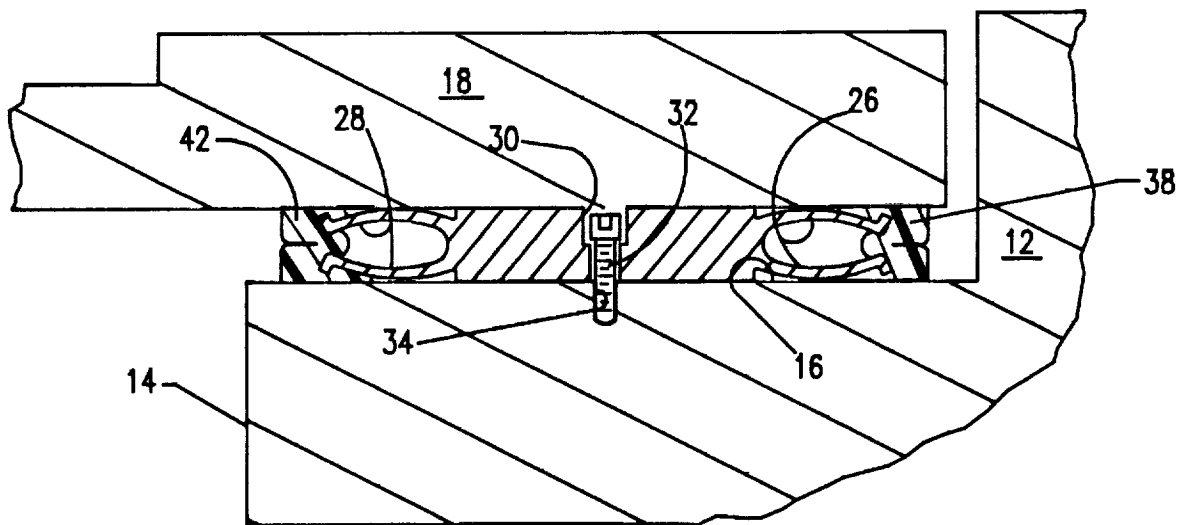


FIG. 3

